



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) EP 0 916 500 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:  
19.05.1999 Bulletin 1999/20

(51) Int. Cl.<sup>6</sup>: B41J 2/16

(21) Application number: 98309372.5

(22) Date of filing: 16.11.1998

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE  
Designated Extension States:  
AL LT LV MK RO SI

(30) Priority: 17.11.1997 JP 315267/97

(71) Applicants:  
• SEIKO EPSON CORPORATION  
Shinjuku-ku, Tokyo 163-0811 (JP)  
• NGK INSULATORS, LTD.  
Nagoya-City, Aichi Prefecture 467-8530 (JP)

(72) Inventors:  
• Okumura, Motonori,  
Seiko Epson Corporation  
Suwa-city, Nagano-prefecture 392-0011 (JP)

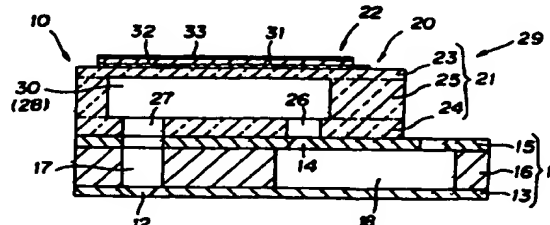
• Wada, Kouchi,  
Seiko Epson Corporation  
Suwa-city, Nagano-prefecture 392-0011 (JP)  
• Furuta, Tadao,  
Seiko Epson Corporation  
Suwa-city, Nagano-prefecture 392-0011 (JP)  
• Yano, Shinsuke  
Midori-ku, Nagoya-city, Aichi-prefecture (JP)  
• Yamada, Tomohiro  
Komaki-city, Aichi-prefecture, 485-0811 (JP)  
• Takahashi, Nobuo  
Owariasahi-city, Aichi-prefecture 488-00 (JP)

(74) Representative:  
Paget, Hugh Charles Edward et al  
MEWBURN ELLIS  
York House  
23 Kingsway  
London WC2B 6HP (GB)

(54) Heat treatment method of actuators for an ink jet printer head and method for manufacturing an ink jet printer head

(57) An actuator 20 is prepared which comprises an ink pump section 29 made by forming a spacer plate 25 with a plurality of window portions 28 formed thereon, a closure plate 23 stacked on one side of the spacer plate 25 for covering the window portions 28 and a connection plate 24 stacked on the other side of the spacer plate 25 for covering the above window portions 28 respectively of ceramic green sheets in lamination to integrally fire them, and a piezoelectric/electrostrictive operating section 22 composed of electrodes 31, 33 and a piezoelectric/electrostrictive layer 32 on the outer surface of the closure plate 23. Thereafter, the actuator 20 is pasted to a holding adhesive film and the holding adhesive film is stripped from the actuator 20 after subjecting the actuator to a given inspection if necessary or to cutting into a given shape if necessary. Subsequently the actuator 20 is heat-treated. Then, onto this actuator 20, an ink nozzle member 11 with a plurality of nozzle holes 12 is stacked and joined. The ink jet print head has a strong joining and an improvement in liquid resistance.

Fig.1



EP 0 916 500 A2

## Description

## Background of the Invention and Related Art Statement

5 [0001] The present invention relates to a heat treatment method of actuators for an ink jet printer heads and method for manufacturing an ink jet printer head.

[0002] As shown in Figs. 1 and 2, the ink jet printer head is so constructed by integrally joining a piezoelectric/electrostrictive film type chip 10 into which a plurality of actuators 20 are integrated and an ink nozzle member 11 with a plurality of nozzle holes 12 opened corresponding to the individual actuators 20 that the ink supplied into the pressure chamber 30 formed in an actuator 20 is jetted through its nozzle hole 12.

10 [0003] The ink nozzle member 11 is constructed by laminating a thin planar nozzle plate 13 provided with a plurality of nozzle holes 12 and a similarly thin planar orifice plate 15 provided with a plurality of orifice holes 14, with a flow path plate 16 interposed therebetween to integrally join them with an adhesive or the like. Inside the ink nozzle member 11, an ink jet pass 17 for leading ink to nozzle holes 12 and an ink supply flow paths 18 for leading ink to orifice holes 14 are formed. Incidentally, these ink nozzle members 11 are normally made of metal or plastics.

15 [0004] An actuator 20 comprises a ceramic substrate 21 and a piezoelectric/electrostrictive operating section 22 integrally formed on the ceramic substrate 21. The ceramic substrate 21 is integrally composed a thin planar closure plate 23 and a thin planar connection plate 24 stacked together with a spacer plate 25 interposed therebetween to form an ink pump section 29. Incidentally, these closure plate 23, connection plate 24 and spacer plate 25 are respectively  
20 formed of ceramic green sheets by lamination and integrally fired to make an ink pump section. Here, in the connection plate 24, a first communicative opening 26 and a second communicative opening 27 are formed at the respective positions corresponding to the orifice hole 14 formed on an orifice plate 15 of an ink nozzle member 11.

[0005] In the spacer plate 25, a plurality of window sections 28 are formed, while a spacer plate 25 and a connection plate 24 are stacked together so as to allow the first communicative opening 26 and a second communicative opening 27 provided on the connection plate 24 to be opened against each window section 28. Besides, on the side opposed to the stacked one of the spacer plate 25 with the connection plates 24, the closure plate 23, with which the opening of the window section 28 is covered.

[0006] In this manner, the pressure chamber 30 is formed inside this ceramics substrate 21.

30 [0007] And, on the outer surface of the closure plate 23 in the ceramic substrate 21, the respective piezoelectric/electrostrictive operating sections 22 are provided at the sites corresponding to individual pressure chambers 30. Here, a piezoelectric/ electrostrictive operating sections 22 comprises a lower electrode 31, a piezoelectric/electrostrictive layer 32 and an upper electrode 33.

[0008] As described above, the ink jet printer head comprises an actuator made of ceramics body and an ink nozzle member, both of which are normally joined by using an adhesive.

35 [0009] When an actuator and an ink nozzle member are joined by using an adhesive like this to manufacture an ink jet printer head, however, there has frequently occurred a situation that the actuator and the ink nozzle member are stripped off each from other under action of ink at the time of use. As a result of investigation into this situation, the present inventor found that this originated in slight traces of adhesive remaining in the actuator.

40 [0010] Namely, after prepared as a piezoelectric/electrostrictive film type chip 10 in which a plurality of actuators 20 are integrated as shown in Fig. 2, an actuator is adhered to a holding adhesive film such as dicing film and subjected to a given inspection if necessary to clarify whether or not the actuator 20 manifests a desired performance or the like. And, after the inspection, the adhesive film is striped if necessary from an actuator cut in a given shape and then the actuator is joined to an ink nozzle member via an adhesive. However, it became clear that slight traces of adhesive of the adhesive film remained in the actuator at the time of stripping an adhesive film from the actuator, which resulted in  
45 damages to the adhesive effect of an adhesive between the actuator and the ink nozzle member.

## Summary of the Invention

50 [0011] As a result of various examinations for a removal of traces of adhesive remaining in an actuator, the present inventor found that heat treatment at a given temperature was effective for a removal of the adhesive and effective for the peeling of the actuator from an ink nozzle member under action of ink and accordingly reached the present invention.

55 [0012]—According to the present invention, there is provided a heat treatment method of actuators for an ink jet printer head comprising the steps of preparing an actuator comprising: an ink pump section made by integral firing of a spacer plate with a plurality of window portions formed thereon, a closure plate stacked on one side of the spacer plate for covering the above window portions and a connection plate stacked on the other side of the spacer plate for covering the above window portions formed respectively of ceramic green sheets by lamination; and a piezoelectric/ electrostrictive operating section composed of electrodes and a piezoelectric/electrostrictive layer on the outer surface of the closure

plate, thereafter pasting the actuator onto a holding adhesive film, stripping the holding adhesive film from the actuator after subjecting the actuator to a given inspection if necessary or to cutting into a given shape if necessary and subsequently heat treating the actuator.

[0013] In the present invention, the heat treatment of an actuator is carried out preferably at temperatures or higher where the weight reduction stops in the thermogravimetric (TG) analysis or the decomposition or combustion of an adhesive ends.

[0014] Besides, in the present invention, the heat treatment of an actuator is carried out preferably by maintaining the treating temperature for more than 10 min. at temperatures or higher where the weight reduction stops in the TG analysis, as seeing from the result shown in Table 1 mentioned below. Since maintaining the temperature for more than 10 min. in the atmosphere leads to a complete removal of the residual carbon after the combustion of an adhesive or a scattering of the moisture adsorbed on the actuator surface, the adhesion is stabilized. More preferably in the heat treatment of an actuator, it is desired to maintain the temperature for more than 30 min. However, these maintained periods mean preferable ones near higher temperatures than the above one (temperature where the weight reduction stops in the TG analysis) as heat treatment temperatures. If heat treatment is carried out at a considerably higher temperature than the above one (temperature where the weight reduction stops in the TG analysis), its effect increases and consequently an equivalent effect can be expected even for a shorter maintained period.

[0015] Furthermore, according to the present invention, there is provided a method for manufacturing an ink jet printer head comprising the steps of preparing an actuator comprising: an ink pump section made by integral firing of a spacer plate with a plurality of window portions formed thereon, a closure plate stacked on one side of the spacer plate for covering the above window portions and a connection plate stacked on the other side of the spacer plate for covering the above window portions formed respectively of ceramic green sheets by lamination; and a piezoelectric/electrostrictive operating section composed of electrodes and a piezoelectric/ electrostrictive layer on the outer surface of the above closure plate, thereafter pasting the actuator onto a holding adhesive film, stripping the holding adhesive film from the actuator after subjecting the actuator to a given inspection if necessary or to cutting into a given shape if necessary, subsequently heat-treating the actuator and then stacking and joining an ink nozzle member with a plurality of nozzle holes to the actuator.

[0016] In the present invention, it is preferred to joining the actuator and the ink nozzle member with an adhesive interposed therebetween and in this case it is preferred to use a thermosetting resin adhesive as the adhesive.

[0017] Besides, in view of improvement in liquid resistance as resistance to ink, it is preferable that the junction surface to the nozzle has a surface roughness Ra of 0.05 to 0.25  $\mu\text{m}$  because of enhancing the adhesive strength and further increasing the interface distance A between the adhesive 1 and the actuator surface 2 as shown in Fig. 4.

#### Brief Description of the Drawings

[0018]

Fig. 1 is a sectional view showing one example of actuator.

Fig. 2 is a plan illustration showing one example of piezoelectric/electrostrictive film type chip.

Fig. 3 is a graph showing the TG analysis data of actually used adhesives.

Fig. 4 is an illustration showing the interfacial distance between the adhesive and the actuator surface.

#### Detailed Description of Preferred Embodiment

[0019] The present invention is featured by heat-treating an actuator before joining the actuator and an ink nozzle member. Namely, an actuator is prepared which comprises an ink pump section made by laminatedly forming a spacer plate and a closure plate and a connection plate respectively of ceramic green sheets and integrally firing them with a spacer plate interposed therebetween and a piezoelectric/electrostrictive operating section composed of electrodes and a piezoelectric/ electrostrictive layer on the outer surface of the above closure plate. Then, the actuator is pasted onto a holding adhesive film and the holding adhesive film is stripped from the actuator after subjecting the actuator to a given inspection if necessary or to cutting into a given shape if necessary. At this time, traces of adhesive of the adhesive film remains on the adhesion surface of the adhesive film in the actuator even after stripping the adhesive film. Thus, in the present invention, the actuator after stripping the adhesive film is heat-treated.

[0020] For a combustive removal or scattering of the adhesive remaining in an actuator, any heat treatment method may be adopted, but generally it is advisable to maintain an actuator for more than a given period of time at a given temperature or higher preferably for more than 30 min. during the heat treatment because of enabling the adhesive to be removed simply and surely.

[0021] According to experiments of the present inventor, it was confirmed that, if the temperature where the weight reduction of the adhesive stops was found to be 500°C on the TG analysis, the adhesive can be combustively removed

or scattered by the heat treatment at a temperature of 500°C or higher in the atmosphere and no such problems as stripping occurs in the case of subsequently joining the actuator and an ink nozzle member by using a thermosetting resin adhesive. Fig. 3 is a graph showing an example of the temperature where the weight reduction of the adhesive stops being 500°C, based on TG analysis data of the actually employed adhesive.

[0022] In the present invention, there is no special restriction on adhesives employed for joining an actuator and an ink nozzle member, but the type of adhesives employed differs with the material of an ink nozzle member for a ceramic actuator. As ink nozzle members, those made of metal or plastics such as SUS may be used, whereas it is desired as adhesives to employ thermosetting resin adhesives such as polyester, polyamide, nylon, ethylene-acetic-vinyl, polyolefine, urethane and polyethylene for joining.

[0023] Besides, if the ink nozzle member is made of ceramics, it is preferable to employ a ceramic adhesive similar in material to the constituent of an actuator.

[0024] Furthermore, it is desired from the viewpoint of adhesion strength that the junctional surface of an actuator is somewhat rough rather than smooth. To be specific, the junctional surface of an actuator has a surface roughness Ra of preferably 0.05 to 0.25  $\mu\text{m}$  and more preferably 0.07 to 0.25  $\mu\text{m}$  because of enhancing the adhesion strength and further increasing the interface distance between the adhesive and the actuator surface, thus promoting the liquid resistance as resistance to ink.

[0025] It is desired that the junctional surface of an actuator has a surface roughness of not more than 0.25  $\mu\text{m}$ , since adhesion strength reduces due to entrainment of bubble into the junctional interface when the junctional surface is too rough beyond said range.

#### Examples

[0026] Hereinafter, referring to the examples, the present invention will be described in further detail.

#### (Example 1)

[0027] To manufacture an ink jet printer head having the configuration shown in Fig. 1, the piezoelectric/electrostrictive film type chip 10 of Fig. 2 with a plurality of actuators 20 integrated was prepared.

[0028] Next, after pasting this piezoelectric/electrostrictive film type chip to a dicing film (adhesive film) by using an adhesive of acryl resin and urethane resin, the dicing film was stripped from the piezoelectric/electrostrictive film type chip (actuator) and subjected to heat treatment. The heat treatment conditions were chosen as shown in Table 1. Incidentally, in Table 1, belt and batch signify those heat-treated in a belt furnace and in a batch furnace, respectively.

[0029] After the heat treatment, each actuator was cut out from the piezoelectric/electrostrictive film type chip and stacked on and joined to an ink nozzle member with a thermosetting resin adhesive (softening point: 100°C) interposed therebetween. On the obtained ink jet printer head, a liquid resistance test was made.

[0030] In the liquid resistance test, the quality was judged by checking the ink leakage with the ink jet printer head dipped in an ink liquid at a given temperature for a given period of time. The result is shown in Table 1.

[Table 1]

No.	Heat Treatment Conditions			Liquid Resistance Test Conditions		Liquid Resistance Test Result	Judgment
	Temperature (°C)	Time (min.)	Method	Temperature (°C)	Time (hr)		
1	530	10	belt	60	120	4/5	X
2	530	30	belt	60	120	1/5 (small leakage)	△
3	530	50	belt	60	120	0/5	○
4	550	30	belt	60	120	1/5	△
5	550	50	belt	60	120	0/5	○
6	570	30	belt	60	120	0/5	○
7	570	50	belt	60	120	0/5	○

[Table 1] (continued)

No.	Heat Treatment Conditions			Liquid Resistance Test Conditions		Liquid Resistance Test Result	Judgment
	Temperature (°C)	Time (min.)	Method	Temperature (°C)	Time (hr)		
8	600	30	belt	60	120	0/5	○
9	500	10	batch	60	120	4/5	X
10	500	30	batch	60	120	1/5 (small leakage)	△
11	500	60	batch	60	120	0/5	○
12	450	60	batch	60	120	4/5	X

[0031] As evident from the result shown in Table 1, it was confirmed that the residual adhesive derived from the pasting of a dicing film was completely removed by the heat treatment at a temperature of 500°C or higher for a period of time above 30 min. in the atmosphere, thus fully manifesting an adhesion effect of the adhesive.

(Example 2)

[0032] After the an hour heat treatment at 550°C in the atmosphere as with Example 1 by using a piezoelectric/electrostrictive film type chip (actuator) varied in the surface roughness Ra of the junctional surface with an ink nozzle member as shown in Table 2, the ink nozzle member was joined to obtain ink jet print heads.

[0033] On these print heads, a liquid resistance test was made as with Example 1. The result is shown in Table 2.

[0034] Incidentally, the surface roughness Ra was measured with the aide of Form Talysurf-120 of Rank Taylor Bobson Co. Ltd.

[Table 2]

No.	Surface Roughness Ra (μm)	Liquid Resistance Test Conditions		Liquid Resistance Test Result	Judgment
		Temperature (°C)	Time (hr)		
13	0.03	60	120	1/5	△
14	0.03	60	120	0/5	○
15	0.04	60	120	1/10	△
16	0.04	60	120	0/10	○
17	0.05	60	120	0/5	○
18	0.05	60	120	0/5	○
19	0.07	60	120	0/5	○
20	0.10	60	120	0/5	○
21	0.20	60	120	0/5	○
22	0.25	60	120	0/5	○

[0035] From Table 2, it is revealed that the liquid resistance to ink was improved if the junctional surface of an actuator has a surface roughness Ra of 0.05 to 0.25 μm. On the other hand, it is also revealed that the liquid resistance to ink somewhat deteriorated if the junctional surface of an actuator has a surface roughness Ra of less than 0.05 μm.

[0036] As described above, according to the present invention, the holding adhesive film is stripped and a piezoelectric/ electrostrictive film type chip (actuator) is subjected to heat treatment prior to the joining to an ink nozzle member, thereby having an advantage that a strong joining is obtained and the liquid resistance is also improved. Thus, the ink

jet print head obtained according to the present invention is excellent in durability.

# Claims

- 5 1. A heat treatment method of actuator for an ink jet printer head comprising the steps of  
preparing an actuator comprising: an ink pump section made by integral firing of a spacer plate with a plurality  
of window portions formed thereon; a closure plate stacked on one side of the spacer plate for covering said  
10 window portions and a connection plate stacked on the other side of the spacer plate for covering said window  
portions formed respectively of ceramic green sheets by lamination; and a piezoelectric/electrostrictive operat-  
ing section composed of electrodes and a piezoelectric/electrostrictive layer on the outer surface of the closure  
plate,  
thereafter pasting the actuator onto a holding adhesive film,  
15 stripping the holding adhesive film from the actuator after subjecting the actuator to a given inspection if nec-  
essary or to cutting into a given shape if necessary and  
subsequently heat-treating the actuator.
2. A heat treatment method as set forth in claim 1, wherein the heat treatment is carried out at temperature or higher  
where the weight reduction stops in the thermogravimetric (TG) analysis.
- 20 3. A heat treatment method as set forth in claim 1, wherein the heat treatment is carried out by maintaining the treat-  
ing temperature for more than 10 min. at temperature or higher where the weight reduction stops in the thermo-  
gravimetric (TG) analysis.
- 25 4. A method for manufacturing an ink jet print head comprising the steps of  
preparing an actuator comprising: an ink pump section made by integral firing of a spacer plate with a plurality  
of window portions formed thereon, a closure plate stacked on one side of the spacer plate for covering said  
30 window portions and a connection plate stacked on the other side of the spacer plate for covering said window  
portions formed respectively of ceramic green sheets by lamination; and a piezoelectric/electrostrictive operat-  
ing section composed of electrodes and a piezoelectric/electrostrictive layer on the outer surface of said clo-  
sure plate,  
thereafter pasting the actuator onto a holding adhesive film,  
35 stripping the holding adhesive film from the actuator after subjecting the actuator to a given inspection if nec-  
essary or to cutting into a given shape if necessary,  
subsequently heat-treating the actuator and then  
stacking and joining an ink nozzle member with a plurality of nozzle holes to the actuator.
5. A method for manufacturing an ink jet print head as set forth in claim 4, wherein the actuator and the ink nozzle  
40 member are joined with a thermosetting resin adhesive interposed therebetween.
6. A method for manufacturing an ink jet print head as set forth in claim 4, wherein the heat treatment is carried out  
by maintaining the treating temperature for more than 10 min. at temperatures or higher where the weight reduction  
stops in the thermogravimetric (TG) analysis.
- 45 7. A method for manufacturing an ink jet print head as set forth in any one of claims 4 to 6, wherein the junction sur-  
face has a surface roughness Ra of 0.05 to 0.25  $\mu\text{m}$ .

Fig.1

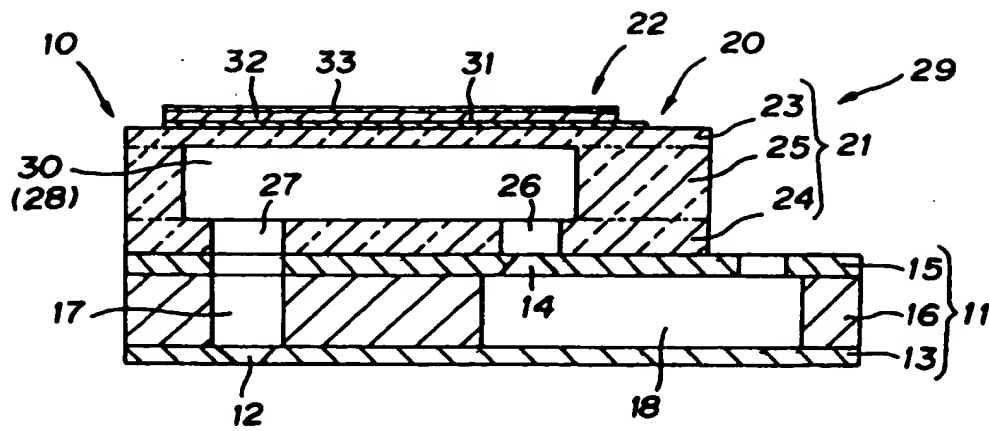


Fig.2

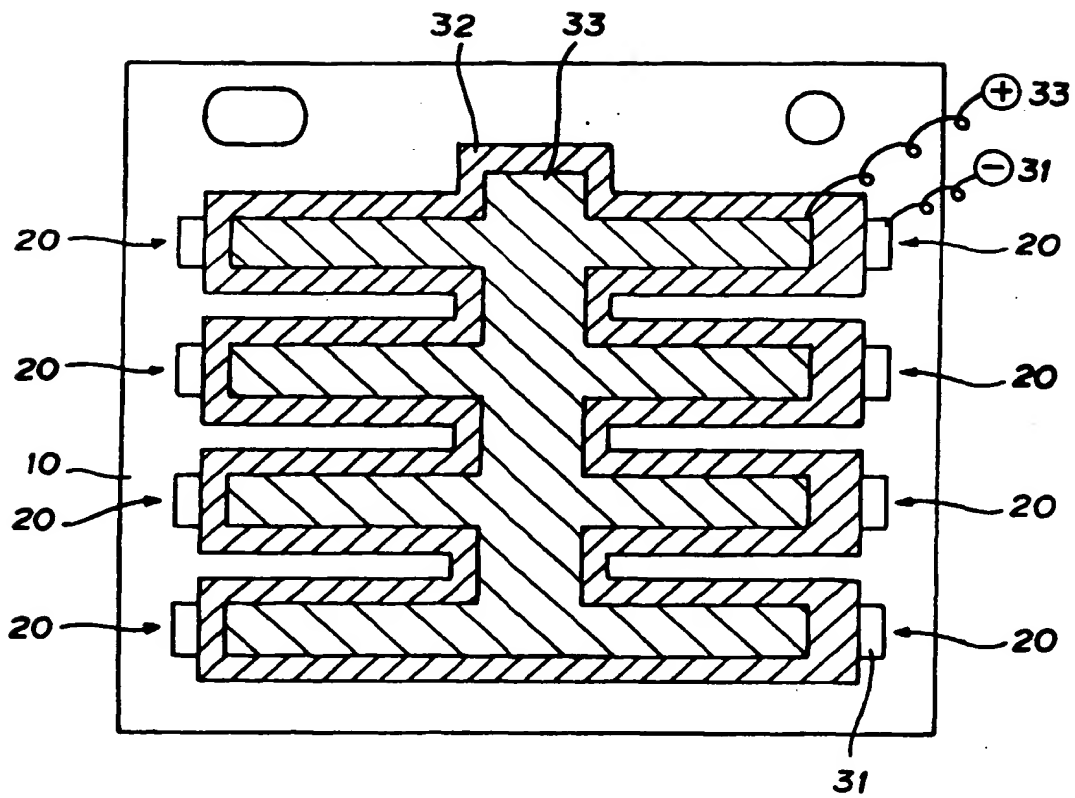




Fig.3

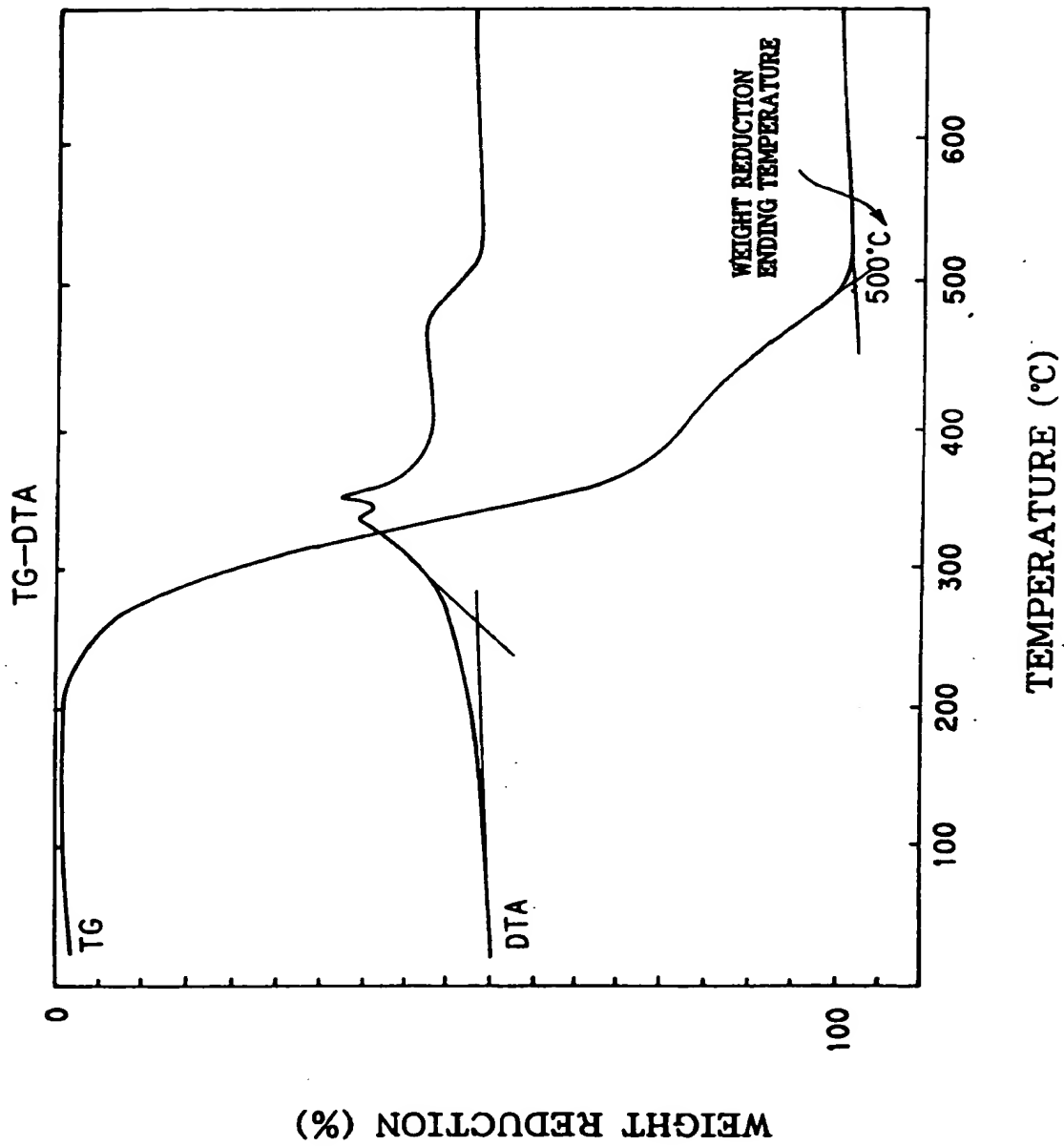
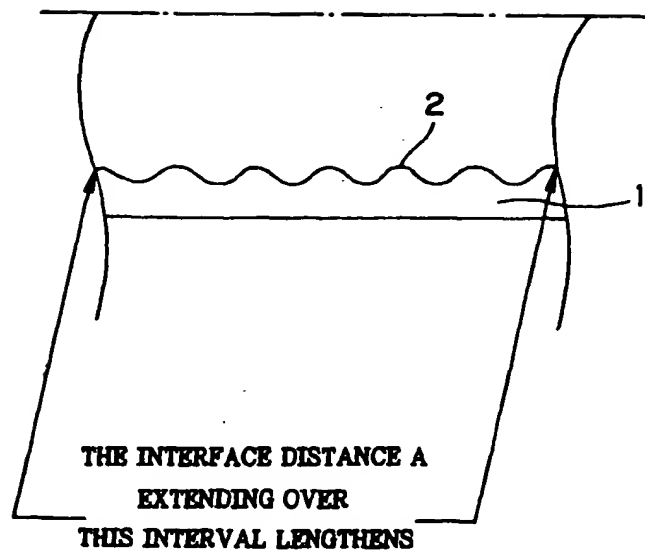
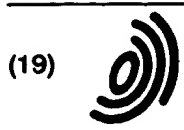


Fig.4





(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 916 500 A3

(12)

## EUROPEAN PATENT APPLICATION

(88) Date of publication A3:  
29.12.1999 Bulletin 1999/52

(51) Int. Cl.<sup>6</sup>: B41J 2/16

(43) Date of publication A2:  
19.05.1999 Bulletin 1999/20

(21) Application number: 98309372.5

(22) Date of filing: 16.11.1998

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FR GB GR IE IT LI LU  
MC NL PT SE  
Designated Extension States:  
AL LT LV MK RO SI

(30) Priority: 17.11.1997 JP 31526797

(71) Applicants:  
• SEIKO EPSON CORPORATION  
Shinjuku-ku, Tokyo 163-0811 (JP)  
• NGK INSULATORS, LTD.  
Nagoya-City, Aichi Prefecture 467-8530 (JP)

(72) Inventors:  
• Okumura, Motonori,  
Seiko Epson Corporation  
Suwa-city, Nagano-prefecture 392-0011 (JP)

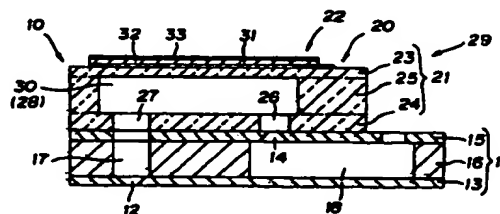
• Wada, Kouichi,  
Seiko Epson Corporation  
Suwa-city, Nagano-prefecture 392-0011 (JP)  
• Furuta, Tadao,  
Seiko Epson Corporation  
Suwa-city, Nagano-prefecture 392-0011 (JP)  
• Yano, Shinsuke  
Midori-ku, Nagoya-city, Aichi-prefecture (JP)  
• Yamada, Tomohiro  
Komaki-city, Aichi-prefecture, 485-0811 (JP)  
• Takahashi, Nobuo  
Owariasahi-city, Aichi-prefecture 488-00 (JP)

(74) Representative:  
Paget, Hugh Charles Edward et al  
MEWBURN ELLIS  
York House  
23 Kingsway  
London WC2B 6HP (GB)

(54) Heat treatment method of actuators for an Ink Jet printer head and method for manufacturing an Ink Jet printer head

(57) An actuator 20 is prepared which comprises an ink pump section 29 made by forming a spacer plate 25 with a plurality of window portions 28 formed thereon, a closure plate 23 stacked on one side of the spacer plate 25 for covering the window portions 28 and a connection plate 24 stacked on the other side of the spacer plate 25 for covering the above window portions 28 respectively of ceramic green sheets in lamination to integrally fire them, and a piezoelectric/electrostrictive operating section 22 composed of electrodes 31, 33 and a piezoelectric/electrostrictive layer 32 on the outer surface of the closure plate 23. Thereafter, the actuator 20 is pasted to a holding adhesive film and the holding adhesive film is stripped from the actuator 20 after subjecting the actuator to a given inspection if necessary or to cutting into a given shape if necessary. Subsequently the actuator 20 is heat-treated. Then, onto this actuator 20, an ink nozzle member 11 with a plurality of nozzle holes 12 is stacked and joined. The ink jet print head has a strong joining and an improvement in liquid resistance.

Fig. 1



EP 0 916 500 A3



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 98 30 9372

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 785 071 A (SEIKO EPSON CORPORATION ET AL.) 23 July 1997 (1997-07-23) * column 1, line 30 - column 3, line 10 * * column 5, line 1 - column 7, line 35; figures 1-4 *	1,4	B41J2/16
A	US 5 622 748 A (TAKEUCHI ET AL.) 22 April 1997 (1997-04-22) * column 3, line 26 - column 6, line 62; figures 1-6 *	1,4	
A,P	EP 0 835 756 A (SEIKO EPSON CORPORATION ET AL.) 15 April 1998 (1998-04-15) * page 5, line 32 - page 6, line 14; figure 9 *	1,4	
A	EP 0 666 605 A (NGK INSULATORS, LTD.) 9 August 1995 (1995-08-09) * page 7, line 21 - page 10, line 10; figures 2-4 *	1,4	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B41J
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 9 November 1999	Examiner Rivero, C
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03 82 (PAC01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 30 9372

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-11-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 785071 A	23-07-1997	EP 0755791 A	29-01-1997
		WO 9703836 A	06-02-1997
		JP 9187931 A	22-07-1997
		JP 9131868 A	20-05-1997
		US 5907340 A	25-05-1999
US 5622748 A	22-04-1997	DE 69025813 D	18-04-1996
		DE 69025813 T	26-09-1996
		DE 69026765 D	05-06-1996
		DE 69026765 T	24-10-1996
		EP 0408305 A	16-01-1991
		EP 0408306 A	16-01-1991
		HK 24197 A	27-02-1997
		JP 2886588 B	26-04-1999
		JP 3128680 A	31-05-1991
		JP 2842448 B	06-01-1999
		JP 3128681 A	31-05-1991
		JP 11206149 A	30-07-1999
		US 5592042 A	07-01-1997
		US 5691593 A	25-11-1997
		US 5631040 A	20-05-1997
EP 835756 A	15-04-1998	JP 10095112 A	14-04-1998
EP 666605 A	09-08-1995	JP 7214779 A	15-08-1995
		DE 69502210 D	04-06-1998
		DE 69502210 T	24-09-1998
		HK 1007056 A	26-03-1999
		SG 49255 A	18-05-1998
		US 5512793 A	30-04-1996

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**THIS PAGE BLANK (USPTO)**